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(54) **[Title of the invention]** Sheet for fixing semiconductor wafers

(57) **[Summary]**

[Objective] Previous heat foaming type reduces tacky adhesion by rupturing micro capsules being mixed with gas by heating, however, there have been a problem that broken pieces of tacky adhesive contaminates chips with this eruption (tacky adhesive of the sheet will transfer to chips when semiconductor wafer which has been once adhered to the sheet with tackiness is picked up after dicing). Further, with ultraviolet ray curing type, there has been a problem that ultraviolet ray irradiation device for curing tacky adhesive is expensive which causes higher cost of products and work efficiency was poor because ultraviolet ray must be irradiated for every single sheet.

[Means to solve] In sheet for fixing semiconductor wafers of which major part is composed with sheet form substrate and pressure sensitive tacky adhesive being laminated on the substrate, to compose the major component of the tacky adhesive with 100 weight parts of base polymer, 10 to 900 weight parts of heat curing type compound and 0.1 to 10 weight parts of heat polymerization initiator.

[Claim]

[Claim 1] In sheet for fixing semiconductor wafers of which major part is composed with sheet form substrate and pressure sensitive tacky adhesive being laminated on the substrate, sheet for fixing semiconductor wafers which is characterized that the major component of the tacky adhesive is composed with 100 weight parts of base polymer, 10 to 900 weight parts of heat curing type compound and 0.1 to 10 weight parts of heat polymerization initiator.

[Detailed explanation of the invention]

[0001]

[Industrial application field] This invention concerns sheets for fixing the semiconductor wafers when cutting and separating a plate shape semiconductor wafers into chips in small pieces, and especially it concerns sheet for fixing semiconductor wafers which does not cause sticking of tacky adhesive even when once adhered semiconductor wafers with tackiness are peeled off, and has high process efficiency.

[0002]

[Prior technology] Previously, sheet for fixing semiconductor wafers have been a product which must hold a plate shape semiconductor wafer by fixing with tacky adhesion from its backside when dicing it into chip shape not to let the chips fly away even when impacts are applied, and on the other hand must easily release without attaching the tacky adhesive on the sheet on the chips when picking up chips which have been diced.

[0003] Accordingly, the sheet for fixing semiconductor wafers is a product which is required to have strong tacky adhesion at dicing, however, is required to have weak tacky adhesion when picking up.

[0004] As these sheets for fixing semiconductor wafers, previously heat foaming type (a type to reduce tacky adhesion by heating to generate foams before pickup process (public notice of Patent Publication Hei 3-268345, for example)), and ultraviolet curing type (a type to reduce tacky adhesion with irradiation of ultraviolet ray before pickup process (public notice of Patent Publication Shou 62-10180, for example)) have been known.

[0005]

[Problems to be solved by this invention] However with the heat foaming type, there have been a problem that although tacky adhesion is reduced by rupturing micro capsules containing gas by heating, ruptured pieces of tacky adhesive contaminate chips with this rupturing (the tacky adhesive of the sheet is transferred to chips when semiconductor wafers which have been once adhered to the sheet with tackiness are picked up after dicing). Further with the ultraviolet ray curing type, there have been a problem that ultraviolet ray irradiation device for curing the tacky adhesive is expensive which causes higher cost of products, and process efficiency was poor because ultraviolet ray must be irradiated on each sheet one by one.

[0006] Accordingly, the objective of this invention is to provide sheet for fixing semiconductor wafers which does not stick tacky adhesive even when once adhered semiconductor wafers with tackiness are peeled off, and is good in work efficiency.

[0007]

[Means to solve the problems] After serious research considering the above described, the inventors completed this invention by discovering that above described problems are solved by lowering tacky adhesion of the pressure sensitive tacky adhesive with heat curing .

[0008] Namely, the sheet for fixing semiconductor wafers concerning this invention is characterized that the major component of the tacky adhesive is composed with 100 weight parts of base polymer, 10 to 900 weight parts of heat curing type compound and 0.1 to 10 weight parts of heat polymerization initiator, in sheet for fixing semiconductor wafers of which major part is composed with sheet form substrate and pressure sensitive tacky adhe-

sive being laminated on the substrate.

[0009] In this invention, entire tacky adhesive which received heating turns into three dimensional network structure to cure which enables to reduce tacky adhesion of the tacky adhesive itself, by making major components of tacky adhesive in above described combination. As concrete value of tacky adhesion, it is desirable that 180 degree peel adhesion (JIS Z 0237) which is within a range of 100 to 1000 gf/20 mm (peel velocity 300 mm/min.) before heating, becomes 0 to 50 gf/20 mm (peel velocity 300 mm/min.) after heating.

[0010] The heat curing type compound in this invention is to reduce its tacky adhesion by generating three dimensional network structure in the entire tacky adhesive with the heating polymerization initiator which has received a heat treatment of 50 to 150 °C, and this formulation ratio is preferably 10 to 900 weight parts, and more preferably it is 20 to 200 weight parts, because if it is too much, it becomes sensitive to heat and causes curing by change of environmental temperature which is poor in storage property, and further it completes curing only with the drying process (100 °C, one minute) at production of the product which is not able to obtain required quality as product, and if it is too little, curing is slow and efficiency of reduction of adhesion becomes poor.

[0011] As the heat curing type compound, low molecular weight compound or oligomer, having at least two or more of photo-polymerizing carbon-carbon double bonds in a molecule which are able to turn into a three dimensional network by heat treatment at 30 to 150 °C, are good, and for example, there are acrylate type compounds and urethane acrylate type oligomers.

[0012] As above described acrylate type compounds, there are such as tri-methylol-propane tri-acrylate, tetra-methylol-methane tetra-acrylate, penta-erythritol tri-acrylate, penta-erythritol tetra-acrylate, di-penta-erythritol mono-hydroxy-penta-acrylate, di-penta-erythritol hexa-acrylate, 1,4-butylene-glycol di-acrylate, 1,6-hexane-diol di-acrylate, polyethylene-glycol di-acrylate and oligo-ester acrylate, for example.

[0013] On the other hand, the urethane acrylate type oligomer is heat curing type compound which has at least two or more of carbon-carbon double bond, and there are those which are obtained by reacting isocyanate terminated urethane pre-polymer which is obtained by reacting polyol compound such as polyester type or polyether type, for example, with polyhydric isocyanate compound such as 2,4-tolylene di-isocyanate, 2,6-tolylene di-isocyanate, 1,3-xylilene di-isocyanate, 1,4-xylilene di-isocyanate and di-phenyl-methane 4,4-di-isocyanate, for example, with acrylate or methacrylate having hydroxy group, such as 2-hydroxy-ethyl acrylate, 2-hydroxy-ethyl methacrylate, 2-hydroxy-propyl acrylate, 2-hydroxy-propyl methacrylate, polyethylene-glycol acrylate and polyethylene-glycol methacrylate, for example.

[0014] Further, when using urethane acrylate type oligomer as heat curing type compound, tacky adhesive will not stick on chips even if semiconductor wafer surface is rough, if one of which molecular weight is especially 300 to 30000, and preferably 100 to 8000.

[0015] Above described heat polymerization initiator in this invention is for curing said heat polymerizing compound when receiving heat treatment to cure entire tacky adhesive itself to reduce its tacky adhesion, and if formulation ratio of this is too high, it becomes sensitive to heat to cause curing by the change of environmental temperature to cause poor storage stability, and further, it cures only by drying process when producing the product (100 °C, one minute) and not able to obtain required quality as the product, and on the contrary, if it is too little, curing is slow and efficiency of reduction of tackiness adhesion becomes poor, therefore, it should be preferably 0.1 to 10 weight parts, and more

preferably it should be 0.5 to 5 weight parts.

[0016] As above described polymerization initiator, organic peroxide derivatives and azo type polymerization initiators are used, however, the azo type polymerization initiators generate nitrogen at heating, thus organic peroxide derivatives are more desirable. As concrete examples of these heat polymerization initiators, there are such as ketone peroxide, peroxy ketal, hydro-peroxide, di-alkyl peroxide, diacyl peroxide, peroxy-ester, peroxy-carbonate and azo-bis-isibutylo-nitrile.

[0017] Amine compounds such as tri-ethyl-amine tetra-ethyl-penta-amine and di-methyl amine may be used as polymerization promoter along with the heat polymerization initiator, as needed.

[0018] Acrylic type tacky adhesives and rubber type tacky adhesives which are known to public may be used, as the base polymer in this invention.

[0019] For the acrylic tacky adhesive, acrylic tacky adhesives which have been known to public may be appropriately selected to use, and in general, there are acrylic copolymers being selected from copolymers of homopolymer (main monomer) having acrylic acid esters as the main composing monomer unit and comonomer, copolymers with other functional monomers (functional group containing monomer), and mixtures of these polymers. Where, as the main monomers, there are such as ethyl acrylate, butyl acrylate and 2-ethyl-hexyl acrylate, and as above described co-monomers, there are such as vinyl acetate, acrylonitrile, acrylamide, styrene, methyl methacrylate and methyl acrylate. Further, as above described functional group containing monomers, there are such as methacrylic acid, acrylic acid, itaconic acid, hydroxy-ethyl methacrylate, hydroxy-propyl methacrylate, di-methyl-amino-ethyl-methacrylate, acryl-amide, methylol acryl-amide, glycidyl methacrylate and maleic acid anhydrate.

[0020] As above described rubber type tacky adhesives, there are such as natural rubber, synthetic isoprene rubber, styrene butadiene rubber, styrene-butadiene block copolymer, styrene-isoprene block copolymer, butyl rubber, poly-isobutylene, poly-butadiene, polyvinyl ether, silicone rubber, polyvinyl-isobutyl ether, chloroprene rubber, nitrile rubber, craft rubber, recycled rubber, styrene-ethylene, butylene block copolymer, styrene-propylene-butylene block copolymer, styrene isoprene block copolymer, acrylonitrile-butadiene copolymer, acrylonitrile-acrylic-ester copolymer, methyl methacrylate-butadiene copolymer, poly-isobutylene-ethylene-propylene copolymer, ethylene vinyl acetate copolymer, poly-isobutylene-silicone rubber and poly-isobutyl ether-chloroprene, for example, and they may not only be alone of these but also they may be mixture of these.

[0021] Further, above described rubber type tacky adhesive may be designed to have increased adhesion before heating by adding tackifier resin as needed. As for this tackifier resin, if it is too little, the effect of tacky adhesion of the tacky adhesive having the elastomer as the main component does not appear, and if it is too much, it gets too soft to cause contamination effect before irradiation to make reduction of tacky adhesion after irradiation harder, therefore, it should be 5 to 100 weight parts and preferably 10 to 30 weight parts.

[0022] As the tackifier resin, there are single of or mixture of such as rosin type resins, terpene type resins, aliphatic group type petroleum resins, aromatic group type petroleum resins, water added petroleum resins, chroman-indene resins, styrene type resins, alkyl-phenol resins and xylene resins, and terpene type resins are desirable considering compatibility with the elastomers. As above described rosin type resins, there are such as rosin, polymerized rosin, water added rosin, rosin ester, water added rosin ester and rosin

modified phenol resin, as above described terpene type resins, there are such as terpene resin, terpene phenol resin, aromatic modified terpene resin and rosin phenol resin. Further, as above described water added petroleum resins, there are such as those in aromatic group, those in di-cyclo-penta-diene type, and those in aliphatic group.

[0023] Further, initial tacky adhesion is able to be arbitrarily set by mixing a hardener into above described tacky adhesive as required. As this hardener, there are such as isocyanate types, epoxy types and aziridine types, they may not only be single substances of them but also may be mixed substances. As above described isocyanate, there are polyhydric isocyanate compounds such as 2,4-tolylene-di-isocyanate, 2,6-tolylene-di-isocyanate, 1,3-xylene-di-isocyanate, 1,4-xylene-di-isocyanate, di-phenyl-methane-4,4'-di-isocyanate, i-phenyl-methane-2,4'-di-isocyanate, 3-methyl-di-phenyl-methane-di-isocyanate, hexa-methylene-di-isocyanate, isophorone-di-isocyanate, di-cyclo-hexyl-methane-4,4'-di-isocyanate, di-cyclo-hexyl-methane-2,4'-di-isocyanate, lysine-isocyanate, phenylene-di-isocyanate, tolylene-di-isocyanate, di-phenyl-meta-di-isocyanate and cyclohexane-di-isocyanate, for example.

[0024] As the above described substrate in sheet shape in this invention, generally various synthetic resin raw materials may be used, and for example, there are single layer or multiple-layers of such as polyvinyl chloride, polybutene, polybutadiene, polyurethane, ethylene-vinyl acetate copolymer, polyethyleneterephthalate, polyethylene and polypropylene. Further, the thickness of the substrate for the sheet for fixing semiconductor wafers is generally selected from a range of 10 to 500 μm.

[0025] Further, the tacky adhesive which is laminated with the sheet for fixing semiconductor wafers concerning this invention is generally formed in a thickness of 5 to 50 μm. This is because if it is too thick, curing by heat treatment becomes slow and if it is too thin, it is not able to function as tacky adhesive (holding wafers). Further, it is able to appropriately select and add such as fillers, aging prevention agent, softening agent stabilizer and colorant which have been previously known to public to the tacky adhesive.

[0026] Further, the sheet for fixing semiconductor wafers concerning this invention is stored by tightly contacting release liner or release sheet such as polyethylene laminated paper or release treated plastic film in the tacky adhesive as needed, and further, the heat polymerizing means may be appropriately selected if it makes the sheet for fixing semiconductor wafers to 50 to 150 °C and not restricted within specific, however, there are such as oven, hot air heater and electric heater.

[0027]

[Form of embodiment of the invention] In this invention, in sheet for fixing semiconductor wafers of which major part is composed with sheet form substrate and pressure sensitive tacky adhesive being laminated on the substrate, the major components of the tacky adhesive is composed with 100 weight parts of base polymer, 10 to 900 weight parts of heat curing type compound and 0.1 to 10 weight parts of heat polymerization initiator, and according to this, initial 180 degree peel strength (JIS Z 0237) which is 100 to 1000 gf/20 mm (peel velocity: 300 mm/min.) reduces to 0 to 50 gf/20 mm by heat polymerization.

[0028] Namely, because of this composition, the sheet for fixing semiconductor wafers concerning this invention does not cause the tacky adhesive sticking to the wafer even when a semiconductor wafer which has been onece adhered by tackiness to the sheet is peeled off, and is able to cure together at once without curing one by one like ultraviolet ray irradiation, which enables to increase work productivity.

[0029]

[Embodiment examples] Major formulated materials and their property values of tacky adhesives of respective embodiment examples and comparative examples of sheets for fixing semiconductor wafers concerning this invention are disclosed in Table 1 and described in detail. Where, values of formulated materials in Table 1 are weight parts.

[0030]

[Table 1]

			Embodiment example				Comparative example	
			1	3	3	4	1	2
formulated substances	base polymer	acrylic tacky adhesive	100	100	-	-	-	-
		acrylic rubber	-	-	100	100	100	100
	heat curing compound		40	40	40	40	5	30
	heat polymerizing initiator		3	3	3	3	3	0.05
	tackifier resin		-	-	20	-	20	20
	hardner		3	3	3	3	3	3
property value	tacky adhesion (gf/20 mm)	before heating	500	500	300	200	350	330
		after heating (100°C x 5 min.)	10	50	10	3	300	330
		after heating (120°C x 5 min.)	3	3	10	3	250	330
	pickup property		O	O	O	O	X	X

[0031] For the base polymer in Table 1 acrylic type tacky adhesive (Olibine BPS5448, made by Toyo Ink Co., Ltd.) was used for Embodiment examples 1 and 2, acrylic rubber (Nippol AR53L, made by Nippon Zeon Co., Ltd.) was used for Embodiment examples 3 and 4 and Comparative examples 1 and 2. Further, for the heat curing type compound, Beamset 575 made by Arakawa Chemical Industry Co., Ltd. was used as oligomer, for heat polymerization initiator, Peroil TCP made by Nihon Oil and Fat Co., Ltd. as peroxy di-carbonate was used in Embodiment examples 1,3 and 4 and Comparative Examples 1 and 2, and Perbutyl O made by Nihon Oil and Fat Co., Ltd. as peroxy ester was used in Embodiment example 2. Further, for the tackifier resin, YS RESIN 1250 made by Yasuhara Chemical Co., Ltd. as terpene resin was used, and for the hardener, Coronate L-45 made by Nippon Polyurethane Industry Co., Ltd. as isocyanate type hardener was used in Embodiment examples 1 through 4 and Comparative examples 1 and 2.

[0032] In the measurement of property values, it was done with tacky adhesives being produced in above described formulation ratios were coated on polyethyleneterephthalate as sheet shape substrate (in 50 μm* thickness) which was selected as 10 μm* thick substrate, and heated to dry for one minute. Further, adhesion after heat treatment was measured after applying 100 °C for 5 minutes and 120 °C for 5 minutes, respectively, as shown in Table 1.

**Translator's note: There are contradictory statements for thickness. Translator can not identify which one is correct.*

[0033] The tacky adhesion in property value in Table 1 are 180 peel adhesion strength (peel velocity 300 mm/min.) which confirms JIS Z 0237 and unit is gf/20mm. Further, "pickup property" shows those wherein chips were able to be picked up after heating with O and those wherein chips were not able to be picked up with X.

[0034] Both Comparative example 1 which

is less in the amount of heat curing type compound and Comparative example 2 which is less in the amount of heat polymerization initiator were inferior in heat curing property, thus has high tacky adhesion even after heating and pickup property was poor. Further, although it is not disclosed in the table, when amount of heat curing type compound and heat polymerization initiator was increased to greater than 900 weight parts and 10 weight parts, respectively, they had thermally polymerized in drying process (100 °C for 1 minute) at production and could not satisfy required quality as a product.

[0035]

[Effect of the invention] In sheet for fixing semiconductor wafers of which major part is composed with a sheet shape substrate and pressure sensitive tacky adhesive being laminated on the substrate, the sheet for fixing semiconductor wafers concerning this invention is composed that major components of the tacky adhesive is composed with 100 weight parts of base polymer, 10 to 900 weight parts of heat curing type compound and 0.1 to 10 weight parts of heat polymerization initiator, and according to this, it is able to reduce 100 to 1000 gf/20 mm (peel velocity at 300 mm/min.) of initial 180 degree peel adhesion strength (JIS Z 0237) down to 0 to 50 gf/20 mm by heat polymerization. Therefore, tacky adhesive does not stick to the wafer with this invention, even when a semiconductor wafer which has been onece adhered with tackiness to the sheet is peeled off, and is able to cure together at once instead of curing one by one like ultraviolet ray irradiation, which enables to improve work efficiency.

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